Title: MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM

Abstract: The present invention discloses a system to collecting the oil at the bottom and transporting until the land without any treatment of the oil. The method allows to remove or substitute those steps of the traditional flow for a simpler flow, in which there is no intermediary process or any change of the oil characteristics, since it is collected at the underwater charge manifold, located at the bottom and that also is connect the producing wells, and transported until the oil delivery at the terminal on shore, where it is received for processing and distribution.

Fig. 3
MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM

Field of Invention

The present invention refers to a modular system for collecting and transporting crude oil produced underwater at the same pressure production condition and without separation of its components. More specifically, the oil production in brute is transported to an onshore plant by means of special collecting containers, dispensing any type of treating.

Background of the Invention

To have a clear view of the current "stat of the art" about offshore production oil, one needs only to look back at the collecting and transporting systems in use when it all started on the late 40's in the Gulf of Mexico. The first wells were drilled not too far away from shore, usually in conjunction with an artificial physical direct connection to shore.

When comparing to today's production numbers, the past days production numbers pales, the offshore production pales even more.

Besides that, we are already producing 1000 meters water depth oilfields, and near to produce 2000 meters water oil fields that are located also hundreds of miles from shore or land facilities.

However changes that have been introduced since those times are mainly referred to technical advances that are incorporated over the equipments and process for carry out each individual step.

The traditional flow for offshore producing oil is composed of the simple following steps, as:

1. the oil rises inside the well at the sea bottom level
2. the oil rises to the surface by means of process floating facilities
3. oil and gas are separated to be exported
4. the gas is recompressed and goes through gas lines to onshore installations
5. the oil goes to land through pipeline or ships
6. oil and gas are received and processed on land facilities for final distribution.
However, it is possible to skip some of the traditional steps by collecting the oil on the wellhead and then, keeping and transporting and delivering the collected oil to the shore facilities in that same "as collected condition".

Summary of the Invention

The present invention discloses a different method to collecting the oil at the bottom and transporting until the land without any treatment of the oil. The system allows to remove or substitute those steps of the traditional by collecting and storing temporarily the oil directly from the wellhead and subsequently transporting and delivering the oil to the shore facilities in that same collected condition. Those steps that has been removed allows for a simpler flow, in which there is no intermediary process or any change of the oil characteristics, since it is collected at the underwater charge manifold, fixed at the bottom and that also is connected to the producing wells, and transported until the oil delivery at the terminal on shore, where it is received for processing and distribution.

Then, the new approach comprehends the following steps:

1. the oil rises inside the well at the sea bottom level
2. the oil is collected at the bottom in pressure containers and kept in that same conditions
3. when the volume of oil is completed the collecting containers rises to subsurface depths and are then forwarded to shore
4. oil and gas are received and processed on shore facilities for final distribution.

Brief Description of drawings

Figure 1a is a schematic frontal view of new system of the invention.
Figure 1b is a schematic lateral view of new equipment of the invention.
Figure 2 is a schematic view of the equipment of the invention.
Figure 3 is a lateral detailed view of the vessel of the invention.
Description of the Invention
In order to better understand and evaluate the modular system of the invention a detailed description is now presented in connection with the Figures accompanying this report.

The new production field production, temporary storage and transporting system will be composed by the convenient arrangement of the three basic components, listed as:

1- The collecting of produced oil will be done at the bottom of the sea, by means of "inside pressure resistant cargo containers" assembled in such fashion to be a hidrodinamically efficient vessel. Such assembled containers operated the same way as one "underwater dirigible".

2- The cargo transference operations at the bottom are made with the collecting vessel connected and secured to a "docking device" that permits the oil loading and also serves for transference of reinjection fluids.

3- The oil field control operations comes from a ship positioned nearby, that gathered the power and control devices within the living quarters for the controlling crew.

1- The underwater collecting vessel

As can be seen in the Figures 1a and 1b, the collecting of the collecting of the produced oil will be done at the bottom of the sea, by means of inside pressure resistant cargo containers (2), associated with an assembly (3) which embraces the cargo containers (2) forming a vessel (1) in such shape to be hidrodynamically efficient, said vessel (1) being provided with the suitable controls that make possible to be operated in the same way as "underwater dirigibles". The cargo containers (2) are anti-pollution - the air and water separation from the cargo oil is done physically by means of membrane separation located inside the cargo tank (not represented in the figure); the tank operations do not stress said membranes.

"Variable buoyancy" is used for controlling the vertical descend. The vessel (1) goes down by means of controlled exchange of air for water, and
gains positive buoyancy by exchanging water for oil. Besides the "variable buoyancy" for main vertical movement control, the vessel (1) is provided with a suitable set of "electrical powered thrusters" (4) batery powered for fine control of the vessel movements. The diving control is remote, done from the surface. The underwater dirigibles will operate totally in "unnamed mode" when diving, the control will be remote.

Traveling power will be supplied by means of a diesel electric power pack with generators, multiple por unit and controls. It is basically a coupling capable semisubmersible power unit that comprises the navigation and power control cabin, both for traveling and diving, the diesel engines, the generators and the electric pods located in the outrigger arms (5).

The navigation control cabin is located on the upper top of a height-adjustable tower (6) or "snorkel" that keeps the control cabin out of the interface zone when traveling, shorts down for terminal maneuvers and also serve as access and venting / discharging for the engine room.

2- The docking device and cargo transference base

A grate type modular slot structure - "cargo bases" (7) - is fixed at the bottom, near to the wells location and also used as a pipeline end manifold (8), for receiving and controlling multiple producing wells. The use of the modular slot concept, enables the replacement of any of the parts, so the fault part could then be easily brought to the surface for maintenance.

Such structure also serve as docking device, gives physical support to the installation of all necessary modular components that perform the different tasks like those of mechanical guides, or coupling system (9), or the latching and dogging systems and also the connectors for transference of oil cargo and the injection fluids to and from the collecting vessel.

The pumping for reinjection is performed from those cargo bases (7). The fluids comes from shore and the pumping equipment as a part that could be installed when needed, from the beginning of the production, or after the surging mode.

The control and power for the bottom transference operations will be supplied trough a multipurpose umbilical cable that connects the "cargo
bases" to the floating power and control facilities for the oil field (not shown in the figures). Those facilities are located in a ship located nearby that also provides facilities for the operational crew.

3- Oil field production control and power facilities

This is the only facility placed top side, as it floats permanently in a ship conveniently placed in a nearby position. The positioning of that ship is not of the critical type, because there is only a subsurface supported umbilical connection with the bottom, the ship is allowed to "move", so could use a "lazy positioning system" also cheaper than critical ones.

Due to the fact that there is no processing whatsoever, the power needed to run the production operations for the oil field are minimal, power needs are only for the injection pumps, and the valve controlling power and their command signals.

The fluids for reinjection (secondary recovery) will be carried from land to the field on the trip back, and will be unloaded during the oil cargo at the transference base.

The crew of the "travel power module" will also control the diving maneuvers, both ways. The top end of the control umbilical shall be able to be disconnected from the control unit, and wait floating for further recovery and reconnection with the diving control unit.

When the vessel is "docked" at the bottom base, the loading flows in both ways, of the oil and the reinjection fluids, are controlled from the field control facilities.

Modularity was a very important part of the original conception of the whole design of the "modular underwater oil production and transporting system", providing the developed concept with total freedom for tailoring, due to the variable number and disposition of the components, a characteristic that permits easy adaptation to any production numbers.

The main components are designed with modularity inside themselves, all the component parts are redundant and could be added or removed for the sub assembly slot at any time, either for maintenance purposes, or to be upgraded.
Thus achieving a "optimum operation continuum", that will suite very close any particular need will be done by a suitable combination of a control facilities, the existing producing wells, the number of cargo bases, the frequency and the size of the collecting cargo underwater dirigibles, could be used to get the best configuration for any given need.

A typical operational cycle will be described to make easier the comprehension of the invention. Figures 2 and 3 show the main components of the system.

At the end of the descending dive the vessel (1) executes the final approaching maneuver for coupling with the "cargo base" (7) and loading the oil (cargo). The cargo of injection fluids is discharged to the pumping system, which operation is performed together and simultaneously within the oil loading, on the same volume basis. The proper balance of those volumes is the main goal of the cargo transference controls.

After the containers are full of oil, the vessel (1) disengages from the cargo base (7) and ascends straight to the surface. With the vessel floating at the surface a "diesel electric drive multiple pod unit power and traveling control pack" (4) is connected to the bow for subsurface traveling.

The trips from the oil field to the shore terminal are performed at "snorkel depth". At the terminal area the subfloats are way up for "discharging maneuvers". The land terminal discharging maneuvers is done through a "high pressure onshore terminal" that will also make the transference of the injection fluids for secondary recovery. After the discharging, if there is no need of reinjection fluid cargo, the underwater trip back is made with ballast.

The duration time of that path is used for "pressure up" the "diving control tanks" and also for recharging the batteries of the diving control thrusters. When the vessel arrives at the dive spot the diesel power traveling pack is disconnected and a new cycle begins.

The crew of the "diesel electric power unit" will remotely control the dive of the underwater dirigible, after they make the disconnection of the power module from the cargo module.

After the coupling with the cargo base (7), the vessel control is
transferred to the field production crew and will stay that way during the total of the transference period the vessel cargo manifold operations are connected to the cargo base transference manifold (8). When the transferences are done, the tanks are closed and the control returns to the "power module" for the dive up and travel to the land terminal.

During the time for the travels between the offshore oilfield and the discharging terminal the batteries systems, that furnishes power for diving and cargo manifold operations will be recharged and also the diving control tanks will be pressurized for the next dive.

Modular construction results in a very important vantage of the original conception of the underwater system object of the present invention. Due to the fact that some of the steps of the traditional way of offshore oil production are nonexistent, on the new manner here described, some significant efficiency increase is expected and based on the following facts:

- Less steps in any process is a great factor for better results just by simplifying it gets faster, more responsive and also cheaper.
- New fields could produce early, as sun a well is completed and a cargo base is installed.
- Several of the used equipments aren't needed anymore, besides as a bonus we also get free of their problems.
- Because there is no oil process involved whatsoever, there is no need for process facilities.
- Because there are no process facilities there is no platform to support it.
- The oil is collected at the bottom, there is no need to surface the oil to be processed and then be exported again trough pipeline or ships. That also means no production and no exporting raisers.
- With no ships for loading oil there will be no floating offshore loading/cargo terminals.
- Due to the fact great part of the cargo operations are realized underwater and out of the air and sea interface, they are less prone to be affected by adverse surface conditions.
- The total processing of the oil is performed by bigger more efficient on shore process plants, that also cheaper than the offshore ones.
- The same is true for reinjection fluids, they will also be prepared on the shore facilities, and will be carried offshore as cargo on the back traps of the collector vessels, from shore terminals to the field.
- The offshore permanently named equipment as been reduced to a minimum, basically only the production control an power facilities will be at the all the time.
- When all those facts are considered, a picture of a very efficient system is clear, and also that all the new component parts are feasible and/or could be easily constructed using today technologies and engineering.

With the implementation of those new equipment and techniques for offshore oil producing, instead of the traditional way, the impact of the absence of a great number of equipment needed nowadays reduces greatly the equipment acquisition costs, today's mandatory installation and future maintenance costs are also non existent.

One must also include in the list the reduction in crew costs and platform supporting operations, that are not negligible on any considered scale.

Even when we consider the costs for the new equipment needed to perform the offshore oil producing in the described fashion, the reduction of the total costs will be in the 50% level for the pilot system, and even bigger in the near future after the new techniques and equipments are standard.

While the "MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM ", which has now been described with regard to the attached drawings, is being shown as a form of preferred accomplishment of the invention, it will be understood that several changes may be introduced without abandoning the concept presented herein and some elements may be replaced by others with the same technical function, especially the materials and equipment utilized, their sizes, forms and proportions.
CLAIMS

1. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM characterized in that comprehends the following steps:

1- collecting of produced oil - will be done at the bottom of the sea, by means of "inside pressure resistant cargo containers" assembled in such fashion to be a hidrodynamically efficient vessel. Such assembled containers operated the same way as one "underwater dirigible".

2- cargo transference operations at the bottom - are made with the collecting vessel connected and secured to a "docking device" that permits the oil loading and also serves for transference of reinjection fluids.

3- oil field control operations - comes from a ship positioned nearby, that gathered the power and control devices within the living quarters for the controlling crew.

2. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that the collecting of the produced oil will be done at the bottom of the sea, by means of inside pressure resistant cargo containers (2), associated with an assembly (3) which embraces the cargo containers (2) forming a vessel (1) in such shape to be hidrodynamically efficient, said vessel (1) being operated in the same way as underwater dirigibles and provided with suitable set of electrical powered thrusters (4) for fine control of the vessel movements in such manner to allows the maneuvers of the vessel (1) containing the cargo containers (2) for coupling with the cargo base (7) and loading the oil.

3. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that a grate type modular slot structure - cargo bases (7) - is fixed at the bottom, near to the wells location and also used as a pipeline end manifold (8), for receiving and controlling multiple producing wells.

4. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 3, characterized in that the
grate type modular slot structure also serve as docking device, gives physical support to the installation of all necessary modular components that perform the different tasks like those of mechanical guides, coupling system (9), the latching and dogging systems and also the connectors for transference of oil cargo and the injection fluids to and from the collecting vessel.

4. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 3, characterized in that the fluids for reinjection will be carried from land to the field on the trip back, and will be unloaded during the oil cargo at the transference base.

6. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that the cargo containers (2) are anti-pollution; the air and water separation from the cargo oil being done physically by means of membrane separation located inside the cargo tank.

7. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that after the cargo containers (2) are full of oil, the vessel (1) disengages from the cargo base (7) and ascends straight to the surface, with a diesel electric drive multiple pod unit power and traveling control pack (4) connected to the bow for subsurface traveling.

8. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that the trips from the oil field to the shore terminal are performed at snorkel depth and at the terminal area the subfloats are way up for discharging maneuvers.

9. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that the land terminal discharging maneuvers is done trough a hight pressure onshore terminal that will also make the transference of the injection fluids for secondary recovery.

10. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that the
duration time of that path is used for pressure up the diving control tanks and also for recharging the batteries of the diving control thrusters.
AMENDED CLAIMS
received by the International Bureau on 19 JULY 2010 (19.07.2010)

CLAIMS

1. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM characterized in that comprehends:
   - a vessel (1) formed by an inside pressure resistant cargo containers (2) associated with an assembly (3) which embraces said cargo containers (2), in which the produced oil is collected at the bottom of the sea and transported to the surface; said vessel (1) being is provided with a suitable set of electrical powered thrusters (4) for fine control of the vessel movements and means for coupling the vessel (1) with cargo bases (7);
   - cargo bases (7), which comprise a grate type modular slot structure fixed at the bottom, near to the wells location and serve as "docking device" that permits the oil loading and also serves for transference of re-injection fluids and that can be also used as a pipeline end manifold (8), for receiving and controlling multiple producing wells;
   - underwater units that allow to maneuver the vessel (1) and that is operated totally in "unnamed mode" by means of remote control from the surface when diving; the traveling power being supplied by means of a diesel electric power pack with generators, multiple pod unit and controls.

2. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that the vessel (1) goes down by means of controlled exchange of air for water, and gains positive buoyancy by exchanging water for oil; inside of the cargo containers (2) the air and water separation from the oil is done physically by means of a membrane of separation.

3. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that cargo bases (7) give physical support to the installation of all necessary modular components that perform the different tasks like those of mechanical guides, coupling system (9), the latching and dogging systems and also the connectors for transference of oil and the injection fluids to and from the collecting vessel (1).

4. MODULAR UNDERWATER OIL COLLECTING AND
TRANSPORTING SYSTEM according to claims 1 and 3, characterized in that the fluids for re-injection are carried from land to the field on the trip back, and are unloaded during the oil collecting at the cargo base.

5. MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that the underwater units is basically a coupling capable semisubmersible power unit that comprises the navigation and power control cabin, both for traveling and diving, the diesel engines, the generators and the electric pods located in the outrigger arms (5); the navigation control cabin is located on the upper top of a height-adjustable tower (6) or "snorkel" that keeps the control cabin out of the interface zone when traveling, shorts down for terminal maneuvers and also serve as access and venting / discharging for the engine room.

6. A METHOD TO OPERATE A MODULAR UNDERWATER OIL COLLECTING AND TRANSPORTING SYSTEM according to claim 1, characterized in that comprehends the following steps:

- collecting of produced oil from the bottom of the sea, by means of a vessel (1) formed by an inside pressure resistant cargo containers (2) associated with an assembly (3) which embraces said cargo containers (2), and is provided with means for coupling with the cargo bases (7); being the transference operations made with the collecting vessel connected and secured to a "docking device" that permits the oil loading and also serves for transference of re-injection fluids;  
- controlling the oil field operation from a ship positioned nearby, that gathered the power and control devices located within the living quarters for the controlling crew of underwater units that that allow to maneuver the vessel (1);  
- disengaging the vessel (1) from the cargo bases (7) after the cargo containers (2) are full of oil and ascending straight to the surface, with a diesel electric drive multiple pod unit power and traveling control pack (4) connected to the bow for subsurface traveling;  
- transporting the oil collected to a shore terminal at snorkel depth and way up the subtoats at the terminal area for discharging maneuvers, the land
terminal discharging maneuvers being done through a high pressure onshore terminal that also makes the transference of the injection fluids to be used later in a secondary recovery operation.

7. A METHOD according to claim 6, characterized in that the duration time of the oil transportation is used for pressure up the diving control tanks and also for recharging the batteries of the diving control thrusters.
STATEMENT UNDER ARTICLE 19(1)

Based on Article 19(1) of PCT, the applicant requires submitting a replacement of sheets 9/12 and 11/12 of claims, in view of written opinion of the International Search Report Authority.

The new set of claims is now presented complete, wherein some amendments have been introduced in old claims in order to meet the requirements and overcome the fails pointed out. Also, the new claims are provided with reference signs placed in parentheses [Rule 6.2(b)PCTJ.

No new matter has been introduced in the new set of claims.
**A. CLASSIFICATION OF SUBJECT MATTER**

INV. E21B43/01
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

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**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
E21B B63B B63G

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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X Further documents are listed in the continuation of Box C.

X See patent family annex.

* Special categories of cited documents:
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* "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search: 4 May 2010

Date of mailing of the international search report: 18/05/2010

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
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Fax: (+31-70) 340-3016

Authorized officer
Bellingacci, F
INTERNATIONAL SEARCH REPORT

International application No
PCT/BR2009/000285

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